Original Research Article

Impact of Mass Drug Administration on Prevalence of Schistosomiasis in Eight Riverine Communities in the Asuogyaman District of the Eastern Region, Ghana

ABSTRACT

Background: The incidence of schistosomiasis in Ghana and more specifically in the Asuogyaman District had become a noticeable record following the creation of the Akosombo Dam in the early 1960s. This has inevitably since placed an enormous burden on the health service delivery systems in the geographical area. Mass Drug Administration (MDA) of Praziquantel has been used worldwide as a preventive and treatment intervention measure for the disease, and the study area is no exception. The study, therefore, aimed to assess the impact of MDA on the prevalence and associated risk factors of schistosomiasis in eight (8) selected riverine communities within the district.
Methods: A descriptive retrospective cross-sectional study was conducted involving 896 respondents with ages ranging from 2 to 82 years and a mean age of 17 ± 13.78 years. Data were obtained from the Volta River Authority (VRA) Public Health and Environmental Department. Pearson's chi-square tests and logistic regression models were used to assess the association and predict the relationship between variables.
Findings: Out of the 896 respondents, 93 (10.4 %) tested positive for *Schistosomahaematobium*. Proportionally, the Nyameben community had a high prevalence of 25.8 % whiles Mami-Waterkope, and Mangoase both had a low prevalence of 3.2 %. The average uptake of Praziquantel was 41 % across the study area. From the bivariate analysis, the respondents' community of residence was noted as the only statistically significant variable contributing to infection. Respondents aged 13-39 were 1.68 times more likely to be infected compared to their younger counterparts after controlling for all other covariates in the predictive model.
Conclusion: Mass Drug Administration has had a tremendous effect on reducing the prevalence of urinary schistosomiasis to the present level of 10.4 %. However, some "hotspots" like the Nyameben community will require special attention. Communities with low uptake of Praziquantel had a relatively high prevalence of schistosomiasis.

Subject Areas: Public Health
Keywords: Mass Drug Administration, Schistosomiasis, Asuogyaman District, Ghana

1.0 Introduction

Mass Drug Administration (MDA) is the treatment of the entire population in a geographic area with a curative dose without first testing for infection regardless of the presence of disease symptoms [1]. According to the principle of preventive chemotherapy, this essential drug must be safe and inexpensive [2]. The World Health Organization (WHO) regards schistosomiasis and five other tropical diseases, namely Helminthiasis, Lymphatic filariasis, Onchocerciasis, Soil-transmitted helminths, Trachoma, Guinea Worm diseases as Neglected Tropical Diseases (NTD). According to Adenowo *et al.* (2015), NTDs are a group of diseases that cause substantial illness for more than one billion people globally and usually affecting the world's poorest people [3]. Schistosomiasis is second only to malaria in terms of the number of people infected and those at risk of infection [4]. The prevalence of schistosomiasis, at present, is still high in sub-Saharan Africa. Out of 17.5 million people treated globally for schistosomiasis in 2008, 11.7 million are from sub-Saharan Africa [3].

Since the discovery of the cause of urinary Schistosomiasis by Theodor Bilharz in 1851 [5] and the entire disease cycle by Brazilian Piraja da Silva in 1908 [6,7], the disease has moved from infectious disease status to a chronic condition due to the difficulty of completing elimination of worm and eggs from an infected person. In 2016 the WHO estimated more than 89 million people were treated out of at least 206.4 million people who required preventive treatment. Also, it was determined that at least 91.4% of those requiring treatment live in Africa, and school-age children are the most risk group because they tend to spend time swimming, bathing, or fishing in water [8]. Approximately 120 million individuals in sub-Saharan Africa have schistosomiasis-related symptoms, while about 20 million undergo hardship as a result of chronic presentations of the disease of 17.5 million people [3].

Schistosomiasis is a parasitic infection caused by digenetic blood trematode worms of the family *Schistosomatidae* and belongs to the genus Schistosoma [9,10]. The worms are, therefore, commonly known as schistosomes. Sexual reproduction of the schistosomes occurs in the human (definitive host), with many such occurring in intermediate snail host. The eggs of blood fluke leave the human body in urine or faeces, hatch in water and liberate larvae (miracidia) that penetrate freshwater snail hosts. Schistosoma species use freshwater snails as an intermediate host [11].

After several weeks of growth and multiplication, cercariae emerge from the snails and penetrate human skin during contaminative water contact (wading, swimming, washing, etc.). These cercariae then transform and subsequently migrate through the lungs to the liver, where they mature into adult worms. These adult worms move to the veins of the abdominal cavity or of the urinary tract. Most of the eggs produced are trapped in the tissues, but a proportion escapes through the bowel or urinary bladder [12,13]. (See **Fig. 1.0**).

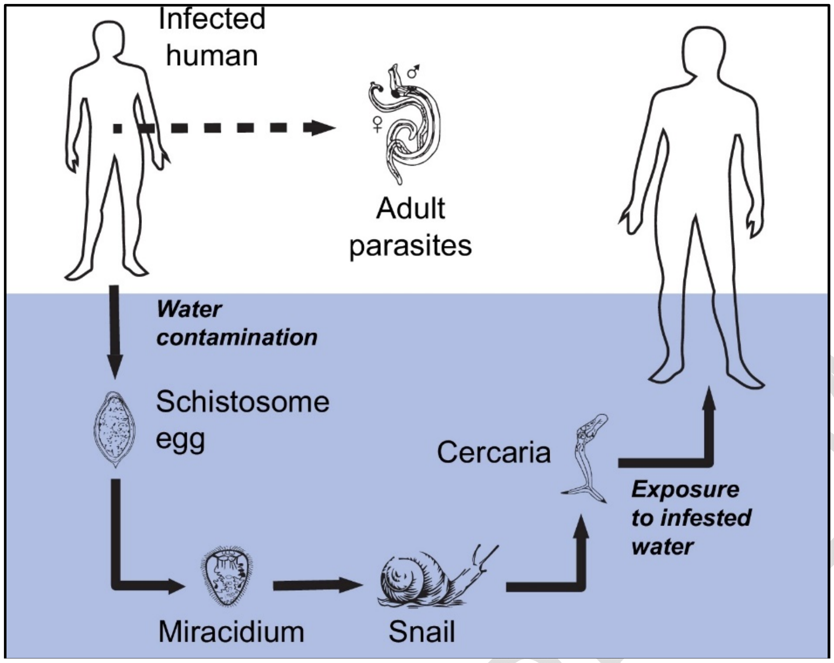

Figure 1.0: *Transmission cycle of schistosomiasis*
Source: Mari *et al.* (2016) [13].

The strategy for schistosomiasis control aims to prevent morbidity in later life through regular treatment with Praziquantel, which is currently the only recommended drug for the infection. Mass drug administration is prescribed for the treatment of most of the neglected tropical diseases due to its cost-effectiveness [14]. Praziquantel is the recommended treatment for schistosomiasis at 40 mg/kg body weight [15,16]. The cost of a single 600-mg tablet is about US$ 0.08, and an average treatment is estimated to be between US$ 0.20–0.30. The combined cost of integrated NTD MDA has been calculated to be in the order of $0.50 per person per year [17]. The commencement of MDA in Ghana started in 1999 with the treatment and prevention of Onchocerciasis, but MDA for treatment of schistosomiasis began in 2008 [18]. The study, therefore, aimed at determining the impact of mass drug administration on the prevalence of schistosomiasis in eight riverine communities in the Asuogyaman District in the Eastern Region of Ghana.

2. METHODS

2.1. Profile of the Research Area

The Asuogyaman District Assembly forms part of the twenty-six (26) Municipalities and Districts in the Eastern Region of Ghana. It covers a total estimated surface area of 1,507 km^2 and constitutes 5.7% of the total area of the Eastern Region. The administrative capital of the District is Atimpoku. The District shares boundaries with Lower Manya Krobo Municipality and Upper Manya Krobo District to the west, to the east with North Tongu District, to the north with

Afram Plains South, and to the south with Dangme West District. The population of the district, according to the 2010 Population and Housing Census, stood at 98,046, with 47,030 males and 51,016 females [19]. The main water bodies include the Volta River and Lake, River Adobo, River Opotoku, the Baware, Anyinase River, and the Bubuakan. The main occupation of the people in most of the communities along the river is fishing. This provides an occupational hazard to the people by increasing their risk of contracting schistosomiasis due to the relatively constant exposure to the infected water/ river. This risk is probably further heightened by the dependence on the water for domestic activities like drinking and cooking as well as a place of convenience.

The study site constitutes selected riverine communities in the Asuogyaman district. The study unit was the voluntary respondent who was tested for urinal and intestinal schistosomiasis whether they had been tested before or not or given Praziquantel previously or not.

2.2 Study Design and Sample Size

The study was conducted retrospectively using secondary data obtained from the VRA Environmental and Public Health Department. Eight riverine communities along the banks of the Volta Lake (Abume, Ghanakpoe, Kokontekpedzi, Mami-Waterkope, Mangoase, Nyameben, Adjena Dornor, and Surveyline) were chosen purposively due to the relatively high prevalence rate of the disease, to ascertain the impact of Praziquantel MDA. The communities were categorized into two (2) zones; the Kpong Headpond and the Upper Volta Zones using their location in relation to the direction of the flow of the river. The study participants of 896 were selected conveniently from the eight communities. Using the estimated total population of Asuogyaman District, a 3.26 % margin of error, and the Confidence level of 95%, the sample size was calculated using Survey Monkey online software [20].

2.3 Data handling and Management

The obtained data were analyzed using Microsoft Excel and STATA statistical software package (*StataCorp.2007. Stata Statistical Software. Release 14*. StataCorp LP, College Station, TX, USA). The prevalence of schistosomiasis in the various communities was deduced from the secondary data obtained. Chi-square tests were used to examine the associations of prevalence with the demographic, socioeconomic, and environmental factors. For each statistically significant factor, an Odds Ratio (OR) and a 95% confidence interval (CI) were computed where the level of statistical significance was set as $p < 0.05$.

2.4. Ethical Consideration

Administrative approvals from the Asuogyaman Directorate of Health Service and VRA Public Health and Environmental Department were respectively sought prior to the gathering of the needed data. Names of participants were deleted from the data obtained to maintain and ensure confidentiality since they were health records. Ethical approval and consideration were also given by the Ethics Review Board of Ensign College of Public Health. Finally, all documents, such as professional and academic articles and other published papers that were collected, were duly acknowledged.

3. RESULTS

3.1. Study Population Characteristics

A total of 896 study records were used in this analysis involving eight (8) communities; six (6) from the lower stream area and two (2) from the upstream area of the Akosombo Dam categorized as the "Kpong Headpond" and "Upper Volta" zones respectively. The study revealed that almost 60% of the records were from Surveyline, Adjena Dornor, Ghanakpoe, and Mami-Waterkope recorded 40.6%, 21.9%, and 21.5%, respectively. The Nyameben community recorded the lowest (7.56%). The mean age of the subjects was 17 ± 13.78 years. While 50.33% of the subjects were female. The majority (79.8%) of the subjects were identified as Ewes. Looking at their occupational status, more than half (68.4%) were students (Table 1).

Table 1**:** Demographic Characteristics of the Respondents

Variable		Indicator	Freq.	%
Zone	**Kpong Headpond**	Abume	113	17.8
		Ghanakpoe	139	21.9
		Kokontekpedzi	98	15.4
		Mami-Waterkope	137	21.5
		Mangoase	100	15.7
		Nyameben	48	7.56
	Upper Volta	Adjena Dornor	106	40.6
		Surveyline	155	59.3
Age group (years)		2 - 12	432	48.2
		13 -39	357	43.2
		40 - 82	77	8.6
Sex		Male	445	49.7
		Female	451	50.33
Ethnicity		Akan	57	6.4
		Ewe	715	79.8
		Others	124	13.8
Occupation		Students	613	68.4
		Traders	77	8.6
		Farmers	25	2.8
		Fisherman	45	5.02
		Others	136	15.16

3.2 Prevalence and Incidence rates of schistosomiasis

The result (Table 2) showed 10.4% of the total subjects tested positive, while the rest tested negative for urinary schistosomiasis. Among the subjects who tested positive in the various communities, the Nyameben community yielded the highest incidence rate of 38 per 1000, while Mami-Waterkope had a low incidence rate of 1.4 per 1000 of the population. The total incidence rate of 75 per 1000 population was estimated for the eight communities. Table 3 below shows the prevalence recorded in the various communities from 2002 to 2016. This evaluation, however, is not done annually for every community. Hence the prevalence rates were not recorded in some of the communities for some particular years. Abume, Adjena Dornor, Ghanakpoe, and Mami-Waterkope recorded their highest prevalence rate of 52.9%, 72.6%, 20.4%, and 43.5% respectively in the year 2010. Kotontekpedzi and Mangoase recorded their highest prevalence rate in the year 2002 and 2003 respectively, while Surveyline recorded its lowest prevalence rate of 6.5% in the tear 2013. Nyameben recorded the highest prevalence rate of 93.5% among the eight communities, and that found in the year 2008.

Table 4 represents bivariate analysis on factors associated with urinary schistosomiasis in the participatory communities within the Asuogyaman District. There was no observed statistical significant association between age groups, sex, occupation, ethnicity and the designated zones with urinary Schistosomiasis ($p = 0.083$), ($p = 0.325$), ($p = 0.079$), ($p = 0.664$) and ($p = 0.718$) respectively. However, the analysis revealed there was very significant associations between urinary schistosomiasis and the community in which they live at ($p <0.0001$).

Table 5 presents the multivariate logistic regression analysis result in assessing factors associated with urinary schistosomiasis. Subjects within age-group (13-39) and (40-82) are 1.83 times and 2.12 times respectively more likely to be infected with schistosomiasis compared to those aged 12 years and below, adjusting for all other variables in the model. Regarding gender, females were 1.28 times more likely to be infected with schistosomiasis compared to the males (AOR = 1.28, 95% CI 0.76-2.15) after controlling for all other covariates. Similarly, subjects living in the Upper Volta zone are 1.46 times more likely to be infected with the disease compared to residents of Kpong Headpond, holding other variables constant (AOR = 1.46, 95% CI 0.60-3.53).

Communities such as Adjena Dornor, Kokontekpedzi, and Nyameben are 0.96 times, 0.25 times and 0.89 times respectively less likely to be infected with schistosomiasis compared to Abume controlling for all other covariates. Concerning the subjects' religious beliefs, the Ewes were 3.23 times more likely to be infected with schistosomiasis compared to the Akan (AOR = 3.23, 95% CI: 0.70-14.92). In contrast, those of the "other" ethnic categories were 57.74 times more likely to be infected. Looking at the subject's occupational status, traders were 0.30 times less likely to be infected compared to the Students (AOR = 0.70, 95% CI: 0.22–2.25). While farmers and fishers were 0.63 times and 0.41 times respectively less likely (AOR = 0.37, 95% CI: 0.08–1.85) (AOR = 0.59, 95% CI: 0.17–2.11). Study subjects classified in the "other" category were 2.17 times more likely to be infected upon adjusting for all other variables.

Table 2. The urinary test result of schistosomiasis from the eight communities from 2015 to 2016.

Result of urine test	Frequency (%)	
Positive test	93(10.4)	
Negative test	803(89.6)	
Subjects tested positive only		
Community	Frequency (%)	Incidence rate per1000
2015		
Abume	15(16.1)	10.7
Adjena Dornor	14(15.1)	10.4
Ghanakpoe	10(10.8)	3.4
Kokontekpedzi	13(14)	4
Mangoase	3(3.2)	2.4
Nyameben	24(25.8)	38.1
Surveyline	11(11.8)	4.4
2016		
Mami-Waterkope	3(3.2)	1.4

Table 3 Recorded prevalence rates of schistosomiasis in eight communities from 2002 to 2016.

Year	**Participatory Communities in the Asuogyaman District**							
	Abume	Adjena Dornor	Ghana-kpoe	Kotonte-kpedzi	Mami-Waterkope	Mangoase	Nyameben	Surveyline
2002				35.9	42.8	54	92.6	
2003						57.8		
2004					33.3			
2005		52.3					58.6	
2006		45.5						
2008	44.5	38.9				51.6	93.5	
2009		15.6						
2010	52.9	72.6	20.4		43.5	8.8		
2011								
2012	32.4	31.5	10.1		40.1		44.9	
2013				13.3				6.5
2014								
2015	13.3	13.2	7.2			3	50	7.1
2016					2.2			

Table 4: *Bivariate analysis of some influential factors of urinary schistosomiasis*

Variables	Urine test result		
	Positive n =93 (%)	**Negative n = 803 (%)**	**P-value**
Age(years)			
0-12	55 (59.14)	377 (46.95)	0.083
13-39	31 (33.33)	356 (44.33)	
40-82	7 (7.53)	70 (8.72)	
Sex			
Male	51 (54.8)	394 (49.1)	0.325
Female	42 (45.2)	409 (50.9)	
Occupation			
Students	69 (74.2)	544 (67.8)	0.079
Traders	8 (8.6)	69 (9.6)	
Farmers	7 (7.5)	38 (4.73)	
Others	6 (6.5)	130 (16.2)	
Ethnicity			
Akan	5 (5.38)	52 (6.48)	0.664
Ewe	78 (83.9)	637 (79.33)	
Others	10 (10.8)	114(14.2)	
Community			
Abume	15 (16.1)	98 (12.20)	<0.0001*
Adjena Dornor	14 (15.05)	92 (11.5)	
Ghanakpoe	10 (10.75)	129 (16.1)	
Kokontekpedzi	13 (13.98)	85 (10.59)	
Mami-Waterkope	3 (3.0)	134 (16.7)	
Mangoase	3 (3.2)	97 (12.1)	
Nyameben	24 (25.81)	24 (3.0)	
Surveyline	11 (11.8)	144 (17.9)	
Zone			
Kpong Headpond	68 (73.1)	567 (70.6)	0.718
Upper Volta	25 (26.9)	236 (29.4)	

Note: *indicates the measured association is statistically significant at $\alpha < 0.05$

Table 5: Multivariate Logistic regression analysis of factors associated with urinary schistosomiasis

Variable	P-value	COR (95% CI)	P-value	AOR (95% CI)
Age				
0-12	Reference	1		
13-39	0.029*	1.68 (1.05-2.66)	0.064	1.83 (0.97-3.48)
40-82	0.371	1.46 (0.64-3.34)	0.213	2.12 (0.65-6.98)
Sex				
Male	Reference	1		
Female	0.293	1.26 (0.82-1.94)	0.348	1.28 (0.76-2.15)
Zone				
Kpong Headpond	Reference	1		
Upper Volta	0.614	1.13 (0.70-1.83)	0.406	1.46 (0.60-3.53)
Community				
Abume	Reference	1		
Adjena Dornor	0.988	1.01 (0.46-2.20)	0.001	0.04 (0.01-0.26)
Ghanakpoe	0.113	1.97 (0.85-4.58)	0.411	1.45 (0.60-3.54)
Kokontekpedzi	0.998	1.00 (0.45-2.22)	0.605	0.75 (0.26-2.20)
Mami-Waterkope	0.003*	6.84 (1.92-24.26)	0.007*	6.36 (1.68-4.10)
Mangoase	0.014*	4.95 (1.39-17.64)	0.024*	7.14 (1.30-9.32)
Nyameben	0.000*	0.15 (0.07-0.34)	0.000*	0.11 (.046-0.25)
Surveyline	0.096	2.00 (0.88-4.55)	-	1
Ethnicity				
Akan	Reference	1		
Ewe	0.617	0.79 (0.30 -2.03)	0.133	3.23 (0.70-14.92)
Others	0.873	1.10 (0.36- 3.37)	0.000*	57.74 (6.24-534.01)
Occupations				
Students	Reference	1		
Traders	0.23	1.09 (0.50-2.37)	0.552	0.70 (0.22-2.25)
Farmers	-0.12	0.93 (0.27-3.19)	0.229	0.37 (0.076-1.85)
Fishermen	-0.87	0.69 (0.29-1.60)	0.421	0.59 (0.17-2.11)
Others	2.32	2.75 (1.17-6.47)	0.123	2.17(0.81-5.81)

Note: *indicates the measured association is statistically significant at $\alpha < 0.05$.

3.3 Prevalence of Intestinal Schistosomiasis and treatment with Praziquantel

Table 6 displays both the stool test result for intestinal schistosomiasis and treatment with Praziquantel in the district. Two (2) subjects representing 0.22% were infected with intestinal schistosomiasis, while 22.99% were not infected. 76.79% of the subjects' infection status with intestinal schistosomiasis was not established. 41 % of the subjects were treated with Praziquantel, while 23.66% were not treated. There was no data on the treatment status of

35.34% of the respondents. Hence they were considered as those who did not receive treatment. Out of the 41% subjects treated with Praziquantel, 12.2 % of the residence at Mami-Waterkope, 6.9% at Surveyline with the least 0.99% at Nyameben. Table 7 represents bivariate analysis on factors associated with treatment with Praziquantel in the Asuogyaman District. There was no observed statistical significant association between age groups, sex, ethnicity, zone and Urogenital schistosomiasis prevalence and treatment with praziquantel (p = 0.646), (p = 0.309), (p = 0.243), (p = 0.412) and (p = 0.75) respectively. However, the analysis revealed there were very significant associations between treatment with Praziquantel and the Community of residence and subjects occupational status at (p = 0.001).

Table 8 presents the multivariate logistic regression analysis of factors associated with treatment with praziquantel Age, sex, the zone of community, ethnicity, occupations and urogenital schistosomiasis infection were not statistically significant predictors of treatment with Praziquantel in the adjusted model. Subjects within the age group of 13-39 and 40-82 are 0.23 times and 0.25 times respectively less likely to go for the praziquantel drugs compared to those 12years and below holding all others variables constant. (AOR= 0.77, 95% CI: 0.54–1.11) and (AOR= 0.75, 95% CI: 0.37–1.52) respectively. Females were 0.09 times less likely to go for praziquantel drug compared to males holding other variables constant (AOR= 0.91, 95% CI: 0.67–1.25). An individual going for the praziquantel drugs in the upper Volta Zone is 1.6 times more likely compared to the Kpong Headpond zone holding all other variables constant (AOR = 1.6, 95% CI: 0.93–2.74). There was an increased likelihood of respondent of Ewe and other ethnic group compared to Akan ethnic group going for praziquantel drugs both in the adjusted (AOR= 1.02, 95% CI:5.13-2.02) and (AOR=1.47, 95% CI: 0.54-3.96) and in the unadjusted model, (COR=1.48, 95% CI:0.30-2.03) and (COR = 1.70 95% CI: 0.36-3.37) respectively.

Subjects who tested positive for urogenital schistosomiasis were 1.05 times more likely to be treated with Praziquantel compared to those who tested negative, holding all other variables constant. In the adjusted analysis, folks in Ghanakpoe were 6.68 times, Kokontekpedzi were 3.13 times, Mangoase were 1.47 times, and Nyameben were 4.65 times more likely to go for praziquantel drugs compared to the Abume community holding all confounding variables constant. Subjects occupied by fishing and other jobs from the simple logistic regression produced statistically significant odds ratio of (COR =2.30, 95% CI: 95% CI 0.29-1.60) and (COR=1.74, 95% CI: 1.17-6.47) compared to respondents who were students.

Table 6 Intestinal Schistosomiasis Stool test and Praziquantel administered

Result of stool test	**Frequency**	**Percentage (%)**
Yes	2	0.22
No	206	22.99
N/A	688	76.79
Total	896	100
Treatment	Frequency	Percent (%)
Yes	370	41

No	212	23.66
No data on them	314	35.34
Total	896	100
For Praziquantel Users only		
Abume	58	6.4
Adjena Dornor	40	4.4
Ghanakpoe	21	2.3
Kokontekpedzi	26	2.9
Mami-Waterkope	110	12.2
Mangoase	44	4.9
Nyameben	9	0.99
Surveyline	62	6.9
Total	370	41

Table 7. Bivariate analysis on the treatment with Praziquantel and some selected variables

Variables	Treatment of Praziquantel Yes. n=370(%)	No. n= 526(%)	P-Valve
Age			
2-12	182 (42.1)	250 (57.9)	0.646
13-39	160 (41.3)	227 (58.7)	
40-82	28 (36.4)	49 (63.6)	
Sex			
Male	176 (40.0)	269 (60.0)	0.309
Female	194 (43.0)	257 (57.0)	
Ethnicity			
Akan	29 (50.9)	28 (49.1)	0.243
Ewe	294 (41.1)	421 (58.9)	
Others	47 (37.9)	77(62.1)	
Community			
Abume	58 (51.3)	55 (48.7)	0.001*
Adjena Dornor	40 (37.7)	66 (62.3)	
Ghanakpoe	21 (15.1)	118 (84.9)	
Kokontekpedzi	26 (26.5)	72 (73.5)	
Mami-Waterkope	110 (80.3)	27 (19.8)	
Mangoase	44 (44.0)	56 (56.0)	
Nyameben	9 (18.8)	39 (81.3)	

Surveyline	62 (40.0)	93 (60.0)	
Occupation			
Students	279 (45.5)	334 (54.5)	0.001*
Traders	23 (29.9)	54 (70.1)	
Farmers	12 (48.0)	13 (52.0)	
Fishermen	12 (26.7)	33 (73.3)	
Others	44 (32.0)	92 (68.0)	
Zone			
Kpong Headpond	268 (42.2)	367 (57.8)	0.412
Upper Volta	102 (39.1)	159 (60.9)	
Urogenital schistosomiasis prevalence			
Positive	30 (32.3)	36 (67.7)	0.075
Negative	340 (42.3)	463 (57.7)	

Note: *indicates the measured association is statistically significant at α < 0.05.

Table 8 Multivariate Logistic regression analysis of factors associated with treatment with Praziquantel

Variables	P-value	COR (95% CI)	P-value	AOR (95% CI)
Age				
2-12	Reference	1		
13-39	0.82	1.03 (1.05-2.66)	0.166	0.77 (0.54-1.11)
40-82	0.344	1.2 (0.64-3.34)	0.423	0.75 (0.37-1.52)
Sex				
Male	Reference	1		
Female	0.292	0.866 (0.82-1.94)	0.56	0.91 (0.67-1.25)
Zone				
Kpong Headpond	Reference	1		
Upper Volta	0.388	1.14 (0.70-1.83)	0.089	1.60 (0.93-2.74)
Community				
Abume	Reference	1		
Adjena Dornor	0.044*	1.74 (0.46-2.20)	0.807	0.88 (0.32-2.41)
Ghanakpoe	0.001*	5.93 (0.85-4.58)	0.001*	6.68 (3.51-12.53)
Kokontekpedzi	0.001*	2.92 (0.45-2.22)	0.002*	3.13 (1.52-6.44)
Mami-Waterkope	0.286	0.26 (1.92-24.26)	0.001*	0.29 (0.16-0.52)
Mangoase	0.001*	1.34 (1.39-17.64)	0.024*	1.47 (0.77-2.82)
Nyameben	0.001*	4.57 (0.07-0.34)	0.001*	4.65 (1.98-10.91)
Surveyline	0.066	1.58 (0.88-4.55)	-	1

Ethnicity				
Akan	Reference	1		
Ewe	0.153	1.48 (0.30 -2.03)	0.96	1.02 (5.13-2.02)
Others	0.102	1.70 (0.36- 3.37)	0.45	1.47 (0.54-3.96)
Occupation				
Students		1		
Traders	0.1	1.96 (0.50-2.37)	0.934	0.70 (0.22-2.25)
Farmers	0.81	0.90 (0.27-3.19)	0.903	0.37 (0.076-1.85)
Fishermen	0.02*	2.30 (0.29-1.60)	0.387	0.59 (0.17-2.11)
Others	0.01*	1.74 (1.17-6.47)	0.563	2.17 (0.81-5.81)
Urogenital schistosomiasis prevalence				
Negative	Reference	1		
Positive	0.06	1.54	0.87	1.05 (0.62-1.75)

Note: *indicates the measured association is statistically significant at $\alpha < 0.05$.

4. Discussion

Despite the relatively low prevalence (10.4%) of urinal Schistosomiasis observed in the study site, it was noted that the incidence rate varies within communities where the Nyameben community produced a high incidence rate of 38 per 1000 of the population. A general observation of the summary of the estimated annual prevalence rates for these communities since 2002 shows that there has been a decline of infection even though, for some of the years, there was a sudden spike in the prevalence. Mangoase, Nyameben, Adjena Dornor, Abume had prevalences of more than 50 % in 2002, but we have now seen a dramatic reduction to about 10 % except in Nyameben.

The national prevalence of Schistosomiasis in Ghana as at 2010 was 70.9 %, which is slightly lower than 1986 and 2003 estimates of 72.5 % [21]. A study done in the Zenu community of Ghana by Tetteh-Quarcoo *et al.* (2013) recorded a prevalence of 30.7% [22]. In Ethiopia, a study done among school children in the Gambella Regional State had a prevalence of 35.9 % [23]. A similar study done in Lusaka, Zambia, also among school-age population recorded a prevalence of 20.72 %, which is much lower than what was observed in this study. A 17.8 % prevalence rate was reported among the Hausa community in Kano State, Nigeria, with no significant difference in the prevalence of urogenital Schistosomiasis (8.3%) and intestinal Schistosomiasis of 8.9 % [10].

In this study, individuals below 12 years of age had a higher prevalence of schistosomiasis, with 55 infections making up of 59.14 %, higher than those above 13 years all together making 40.8 %. Respondents below 12 years of age are likely to be students, and hence this prevalence rate met the WHO classification for an endemic area [17]. A 27.4 % urinary Schistosomiasis prevalence rate was reported among respondents between the ages of 11 and 12 years, 39.1 % for 13– 4-year-old [24]. Agnew-Blais *et al.* (2010) reported a statistically significant associated risk factor of adolescent age 13–17 years and pre-adolescent ages of between 9–12 years of (AOR =3.26, 95%, CI: 2.15– 4.93) and (AOR= 3.33, 95%CI: 2.04–4.79) respectively [25]. Age as exposure to Schistosomiasis infection in this study was not a significant predictor. However, respondents below 18 years of age were reported to be a statistically significant predictor of infection [10]. Folks in the Mangoase and Mami-Waterkope communities were 7.14 and 6.36 respectively times more likely to be exposed to the disease compared to their counterparts in Abume, adjusting for all the other variables.

Out of 896 respondents, males had a higher prevalence of 54.8 %. This outcome was contrary to a similar study conducted by Kabuyaya *et al.* (2017) among school-going children in the Ndumo area in South Africa, which had a prevalence of 60.8 % among females [26]. However, other studies among school children in Mozambique reported prevalences that corroborated the finding in this study that males were more at risk [27]. Fulford *et al*. (1996) observed that in some communities, females had contracted the disease far more than males across age groups, while in other villages, the sexes had almost identical patterns of infection [28]. It is likely that due to sex role differences, exposure to Schistosoma *haematobium* differed a little between males and females. In some Islamic communities, females are not allowed to swim or bathe in open water sources and also do not participate in fishing and irrigation activities [29,30]. Moreover, males were more likely to be knowledgeable of the existence of an open water source in their area compared to females, thereby leading to a higher prevalence among the males [31].

Concerning occupation, there were more students (74.2%) infected than other categories of occupation. Augusto *et al.* (2009) reported farmers had a higher prevalence of infection than non-farmers, while housewives had more cases than Government employees and daily labourers [27]. The result of this study was also supported by that of Salwa *et al.* (2016), who reported that individuals with secondary and tertiary education had a high prevalence of 19.9% among those in education. Among the working and non-working, the non-working had a higher prevalence of 21.7 % [10].

The Kpong Headpond zone communities had a higher prevalence rate of urinary schistosomiasis than communities within the Upper Volta Zone. 68 cases out of 93 cases representing 73.1 % within the Kpong Headpond zone whiles Upper Volta zones had a prevalence of 26.9 %. Kumbu *et al.* (2016) explored the prevalence of Schistosoma *mansoni* infection in four health areas of Kisanthu Health zone in the Democratic Republic of the Congo and reported that children in Kipasa, one of the four health areas, had a high prevalence of schistosomiasis compared to other health areas [32]. They associated the result to the fact that the area is crossed by two rivers, the Lassa river, and the Kiela river, which are incriminated as shelter for snails and that children living there are more closely in contact with these rivers than children living in the other three health areas. The high prevalence in the Kpong Headpond Zone may be due to some of the characteristics studied that might have tipped the balance heavily toward the Kpong zone in terms of the prevalence. The high prevalence in this zone may be significant because the Nyameben community, which has the highest prevalence of urinary schistosomiasis, is situated within it. There was a statistically significant difference between the prevalence of the participatory communities in the study (p=0.001), with Nyameben having a higher prevalence and probably posing a higher risk than the other communities. It may not be surprising because Nyameben is within the Kpong Headpond zone, which had more urinary Schistosomiasis cases. The different prevalence of the communities was collaborated by findings in a study conducted by Satayathum *et al.* (2006) among study subjects in Kenya. They report that a village of residence was consistently a significant predictor of infection and re-infection. They also observed that those at risk for infection were the ones with no piped water and persistently high snail (and human) infection rates. The communities studied had challenges with water and sanitary facilities [33]. In certain areas, toilet facilities were provided, but residents still practise open defecation and in the water, which increases the risk of infection and re-infection. The availability of water and distances of homes from water sources may have played a role in this study, like the those revealed by Azamigo *et al*. (1997) and Clennon *et al.* (2004) [34:35].

Communities like Mangoase and Ghanakpoe, for example, has a number of settlements away from the water and might have accounted for the low prevalence. Bella *et al.* (1980) discovered that some villages who had access to piped water had overall shorter and fewer contacts than the residents in other villages [36]. That had only borehole, wells, and surface water as the main sources of water. And that those with piped water were the same ones that had the lowest risk of infection or re-infection.

Respondents of Ewe background were more infected 78 (83.9%) by urinary schistosomiasis than the other ethnic groups. These results may be attributable to the fact the Ewe respondents among the eight (8) communities were more, making up 715 (79.8%) of the total respondents. Ethnicity was not a significant predictor of infection of schistosomiasis with a p-value of greater than 0.05, as reported in the studies of the following [37:38:39:]. King *et al*. (1988) elaborated in their finding that the influence of ethnicity on infection had been linked to cercarial exposure as opposed to biological differences in susceptibility to infection. In this study, a lower level of schistosomiasis infection was observed in females of Ewe decent than the males whiles there was no clear difference in prevalence in males and females of the Akan ethnic groups [40]. It is was reported by Chaula *et al*. (2014) in a study conducted among school children in the Bahi district of Tanzania that the influence of sex on the re-infection of schistosomiasis appeared to differ depending on the ethnic groups [41]. This observation could likely be attributed to the occupational distributions from these communities as they registered a lot of school going kids. Also, respondents from the other ethnic groupings in this study were observed to be 57.74 times more likely to be contracting urinary schistosomiasis compared to the Akans holding all other variables constant.

The treatment status of a significant number of respondents 314 (35 %) was not available per the data obtained and used; whiles 212 (23.66 %) had no treatment with reasons that were not clear. The rest of the respondents, however, received treatment on the spot during the testing and evaluation exercise in 2015 and 2016. A study done by Bella *et al.* (1980) shows that the completion of assigned treatment drugs of schistosomiasis was a significant predictor of reduced re-infection [36]. King *et al.* (1988) also suggested that praziquantel and full metrifonate regimens were not significantly different in their treatment effects [40]. Satayathum *et al.* (2006) pointed out that there is a certain advantage in choosing the single-dose regimen of Praziquantel for mass therapy, although in the future, drug resistance issues may be changed [4].

In a study to assess the impact of mass drug administration in Bahi, Tanzania, by Chaula *et al*.(2014), it was discovered that there was an increase in uptake of MDA praziquantel from 39.5% in 2011 to 43.6% in 2012 consequently, they reported a decrease in prevalence of S. haematobium by 50 % from 2011 to 2012 [41]. This finding was synonymous with the observation in this study where urogenital schistosomiasis prevalence was very high in a community like Nyameben with low MDA praziquantel uptake of about 1% and approximately 19 % (using the total number of participants who received Praziquantel, 370 and the total number of participant, 896 in the study, as denominators respectively) and prevalence was low (2%) in communities where the uptake was comparatively higher as seen in the case of Mami-Waterkope. Using the same formula, the community recorded an uptake rate of 12.2 % and 80 % higher than the rest of the communities. This rate meets and outperforms the WHO target coverage of 75 % at the community level. The average uptake or coverage per the eight (8) communities representing the Asuogyaman district stood at 41 %, which is relatively lower than the WHO target coverage of 75 % at the community level. In a study done in the Koome Islands, Central Uganda by Tuhebwe *et al*. (2015), they observed that uptake of MDA was more likely if the respondent was knowledgeable about schistosomiasis transmission and prevention. They reported a sub-optimal uptake of schistosomiasis of 44.7 % [42].

5. Conclusions

The prevalence rate of schistosomiasis in eight (8) selected communities in the Asuogyaman District of the Eastern Region of Ghana was very high. Urinary Schistosomiasis was more prevalent in some "hotspot" communities like Nyameben, compared to the rest of the communities, and it was more in males than females by 10 %. The study also revealed that there are more cases in the Kpong Headpond Zone as compared to the Upper Volta zone. The prevalence rate of urinary schistosomiasis by the occupation status of the subjects also revealed the rate was much higher among students compared to those in other occupations. The risk factors that were statistically associated with urinary schistosomiasis were the communities of residence of the cases (Mangoase, Nyameben, and Mami-Waterkope) and other ethnic groups other than Akan and Ewe. Mami-Waterkope with high uptake of Praziquantel had low prevalence, and Nyameben with low uptake had a high prevalence of urinary schistosomiasis.

The Ministry of Health, Regional, and District Health Directorates should integrate Praziquantel administration and also intensify public education on the disease transmission mode among residents in the riverine communities to help sustain community-wide treatment.

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